REMARKS/ARGUMENTS

The Office Action mailed May 18, 2006 has been reviewed and carefully considered. Claims 6-9 are now pending in this application, with claim 6 being the only independent claim. Reconsideration of the above-identified application in view of the following remarks is respectfully requested.

Claim Amendments

New independent claim 6 includes a more detailed delineation of the fuel injection nozzle according to the invention, including "a nozzle needle bore having a central axis and a lower portion comprising a needle seat, an axial dimension of the lower portion being significantly smaller than an axial dimension of the bore", "wherein an entire height of said cooling duct is arranged at said lower portion proximate said needle seat" and "a cooling medium inflow line having a first portion extending axially in the housing and a second portion connecting the first portion to the cooling duct, the inflow line having a cross-sectional area, the cross-sectional area of the cooling duct being approximately twice the cross-sectional area of the inflow line".

Support for the new limitations in claim 6 is found in previous claim 10, at paragraph 0011 and in Fig. 1 of the original disclosure.

Previous claim 10 has thus been canceled.

Further, minor modifications have been made in claim 9.

Claim Rejection Under 35 USC § 103

Claims 6-10 stand rejected under 35 U.S.C. §103(a) as being unpatentable over US Patent No. 5,860,394 (Saito).

Saito discloses a fuel injector 7 with a nozzle holder 10 and a nozzle 11. A needle 12 is housed in a needle aperture 13 formed in the nozzle holder 10. According to a specific embodiment shown in Fig. 10, a cooling water passage 20 is formed in the nozzle holder 10 (col. 5, lines 44-51). The cooling water passage 20 extends substantially in axial direction and has an inlet 21 and an outlet 22 both extending in vertical direction. This construction is deemed to accomplish the task of cooling the nozzle holder 10 sufficiently in order to prevent the formation of deposits around the nozzle 11. "Sufficiently" means in this regard that the temperature of the nozzle holder 10 around the nozzle 11 has to be kept lower than a temperature at which 90 vol.% of the fuel is recovered or distilled (col. 3, lines 25-39), which temperature is approximately 170° C (col. 5, lines 28-33).

Independent claim 6 is allowable over Saito because Saito fails to disclose, teach or suggest (1) "wherein an entire height of said cooling duct is arranged at said lower portion proximate said needle seat"; (2) "the cooling duct being closer to the bore than to the outside surface of the housing"; and (3) "the cross-sectional area of the cooling duct being approximately twice the cross-sectional area of the inflow line", as expressly recited in independent claim 6.

The present invention differs from Saito in many aspects. Regarding the first reason, independent claim 6 recites "a cooling medium inflow line having a first portion extending axially in the housing". Accordingly, a certain amount of heat is already dissipated in the first portion of the inlet which extends axially in the housing so that the actual cooling duct can be dimensioned significantly smaller in the axial direction. Independent claim 6 further recites "a cooling duct arranged around the lower portion of the bore", "wherein an entire height of said cooling duct is arranged at said lower portion proximate said needle seat", and "an axial dimension of the lower portion being significantly smaller than the axial dimension of the bore". Saito fails to teach or

suggest these limitations. In contrast, Saito discloses that the cooling duct extends axially along a majority of the length of the bore (see Fig. 10 of Saito).

Regarding the second reason, the present invention differs from Saito by the limitation of "the cooling duct being closer to the bore than to the outside surface of the housing", as acknowledged by the Examiner. This claimed feature is particularly useful in the lower portion, since the region around the needle seat is subjected to high thermal stress (see paragraph 0004 of the specification). In contrast, Saito discloses that the cooling duct is central between the bore and the outer side. Furthermore, the axial extension of the bore of Saito extends along a majority of the axial length of the bore as described above.

As a third difference, the relation between the cross-sectional areas of the cooling duct and the inflow line is determined by "the cross-sectional area of the cooling duct being approximately twice the cross-sectional area of the inflow line" which is a very precise indication of the ratio between the cross-sectional areas and determines the small overall dimension of the cooling duct even further compared to the structure in Saito, where the ratio of the cross-sectional areas between the cooling water passage 20 and the inlet 21 (Fig. 10) can be estimated to at least 5:1. The ratio of approximately 2:1 on the one hand provides a "relatively high flow rate of the cooling medium through the cooling duct", and on the other hand "dead water regions are also avoided with this design" (paragraph 0011 of the original disclosure).

Thus, these three limitations in combination result in the advantage mentioned in the specification, i.e. an improved thermal dissipation of heat in the most critical areas. Again, this is achieved by keeping the actual cooling duct small, but arranging it close to the bore in the area of the needle seat, and by designing the cooling duct according to very specific requirements, as set forth in amended independent claim 6.

These three limitations distinguishing the present invention according to new claim 6 from the prior art of record are not obvious, but rather define a structure for cooling a fuel injection nozzle which is much more elaborate in its details and thus provides both proper cooling and at the same time providing efficiency, i.e., without dead water regions (see paragraph 0011 of the specification). In particular, a skilled person could not derive any suggestion or motivation from Saito to modify the fuel injection nozzle of Saito according to any of the three lacking limitations, let alone the inventive combination of all three.

Dependent claims 7 to 9, each being dependent on independent claim 6, are allowable for the same reasons expressed above with respect to independent claim 6, as well as for the additional recitations therein.

In view of the above amendments and remarks, the application is now deemed to be in condition for allowance and notice to that effect is solicited.

It is believed that no fees or charges are required at this time in connection with the present application. However, if any fees or charges are required at this time, they may be charged to our Patent and Trademark Office Deposit Account No. 03-2412.

Respectfully submitted,
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